

# Public knowledge, attitude and practices towards antibiotics and antibiotic resistance: a cross-sectional study in Szeged District, Hungary

## Public knowledge toward ABs

MÁRIÓ GAJDÁCS<sup>1,2\*</sup>, EDIT PAULIK<sup>3</sup>, ANDREA SZABÓ<sup>3</sup>

<sup>1</sup>Department of Pharmacodynamics and Biopharmacy, Faculty of Pharmacy, University of Szeged, Szeged, Hungary

<sup>2</sup>Institute of Medical Microbiology, Faculty of Medicine, Semmelweis University, Budapest, Hungary

<sup>3</sup>Department of Public Health, Faculty of Medicine, University of Szeged, Szeged, Hungary

\*Corresponding author: Márió Gajdács

Email: [mariopharma92@gmail.com](mailto:mariopharma92@gmail.com)

Received: 6 March 2020 / Revised: 22 March 2020 / Accepted: 24 March 2020

### Abstract

**Purpose:** The correlation between the levels of antibiotic use (including self-medication with antibiotics) and the development and spread of resistant bacteria has been highlighted by several publications worldwide. The aim of our present study was to assess the knowledge level and attitudes of patients (general population) towards antibiotics and antimicrobial resistance, in addition to their practices towards the procurement and use of these drugs in the Szeged District of Hungary.

**Materials/methods:** A cross-sectional, questionnaire-based pilot study was performed among patients aged 18 years or older in the Szeged District. The study population comprised of adult patients attending their general practitioner's (GP) offices. Data collection for the survey was running between January 2016 and January 2018. Sample size for the adult population of the Szeged District was calculated by using the Raosoft sample size calculator.

**Results:** Responses from  $n=109$  were included in the final analysis. The median age of the respondents was 51 years ( $50.8 \pm 17.8$  years, range: 19-93). The majority of respondents were from the seat of the district and the county (Szeged;  $n=62$ ; 56.9%). 53.7% ( $n=59$ ) reported having a chronic illness which requires medical attention/pharmacotherapy. Almost one-third (32.1%) has taken these drugs during the last 12 months. 90.5% ( $n=99$ ) of respondents has obtained their last course of ABs through a medical prescription. The average number of correct answers overall were  $2.11 \pm 1.16$ ; highest level of education ( $p < 0.001$ ) and reported use of antibiotics for inappropriate indications (e.g., sore throat, cold, flu, fever) showed significant associated in the results of knowledge-based questions ( $p=0.03$ ).

**Conclusions:** As the number of available antibiotics is dwindling, one of the most important steps to preserve the efficacy of existing drugs is the use of educational campaigns in an attempt to augment the health behaviour of patients. Higher education levels were associated with better knowledge and attitudes, in addition, the majority of respondents were not aware of the differences between bacterial and viral infections and their treatment. This study has built on existing research and generated data which may be used for the designing and implementation of awareness campaigns, based on the needs of the local community.

**Keywords:** antibacterial agent, drug resistance, public, knowledge, attitude, questionnaire, Eurobarometer

## 1. Introduction

Antimicrobial resistance (AMR) is one of the most relevant concerns of modern medicine worldwide: these drugs, considered as *panacea* for the treatment of previously deadly infections are losing their effectiveness, resulting in increased mortality rate and decreased quality of life in the affected patient population [1,2]. The withdrawal of major pharmaceutical companies from the field of antimicrobial R&D means that healthcare professionals have to make due with the drugs that are already available [3,4]. In fact, one of the main requirements for even the "Health for all by 2000" (World Health Organization, 1981) was the availability of effective antibiotics: therefore, one of the main setbacks of this program was the rapid glob-

al emergence of AMR [5,6]. The situation of antibiotic availability has not improved substantially since the beginning of the 21<sup>st</sup> century; in a current report from the WHO, the lack of novel antibiotic has once again been cited as a significant threat to medicine [7]. Infections caused by resistant bacterial pathogens are also sources of significant financial losses (both corresponding to increased expenses for the healthcare infrastructure and loss of profits from decreased productivity): in the United States, these financial losses have been estimated to be around 50-60 billion US dollars, while in the European Union, these figures may go up as high as 1.5 billion euros [1,8].

Hungary ranks low in the total consumption of antibiotics (ABs) in Europe, both in the community and in hospital settings (with a consumption of

15.4 and 1.18 defined daily doses [DDD] per 1000 inhabitants per day, respectively, based on the latest data of the ECDC [EU/EEA average: 21.9 and 2.06 DDD per 1000 inhabitants per day, respectively], however, the country is a leader in the consumption of broad-spectrum agents (predominantly fluoroquinolones) instead of narrow-spectrum drugs [9,10]. The correlation between the levels of AB use (including self-medication with ABs) and the development and spread of resistant bacteria has been highlighted by several publications worldwide [11]. Although the relationship is complex, the increased utilization of ABs drives increases in resistance levels; therefore, the prudent use of these agents is of utmost importance [12]. In addition to the responsibility of various healthcare professionals (HCPs) (i.e. the compliance of prescribing physicians, pharmacists, nurses with national and international guidelines and regulations, restriction of non-prescription AB sales, proper instructions given by HCPs [13-17]), the populations' knowledge and attitudes on AB use and resistance has been shown to significantly influence antibiotic consumption worldwide [18].

Apart from the knowledge of the general population, the social aspects of AMR and improper antibiotic use are increasingly being recognized as an important facet of this issue: the insufficient social awareness of antibiotic resistance may lead to exaggerated expectations for AB prescriptions from the public; in addition, the socio-economic status, education level, residential background, cultural factors, vulnerable population status, desperate need to maintain employment despite the presence of symptoms of bacterial diseases or discrimination may all influence behavioural biases, health literacy and health-related decision-making processes in the general population [19,20]. These issues are usually addressed via awareness-raising and educational campaigns, both aimed at HCPs and the public. Among the campaigns with the largest impact, the European Antibiotic Awareness Day (EAAD; 18<sup>th</sup> of November) organized by the European Centers for Disease Control and Prevention (ECDC) and the World Antibiotic Awareness Week (18-24<sup>th</sup> of November in 2019) by the WHO are among the most notable.

Preceding research on the treatment-seeking behaviors and attitudes of the European population has prompted our research interest to investigate current trends in our local setting [21]. The aim of our present study was to assess the knowledge level and attitudes of patients (general popu-

lation) towards AB and AMR, in addition to their practices towards the procurement and use of these drugs in the Szeged District of Hungary.

## 2. Materials and methods

### 2.1. Sample size and study location

A cross-sectional, questionnaire-based pilot study was performed among patients aged 18 years or older in the Szeged District. The Szeged District is located in Csongrád County, in the Southern Great Plain of Hungary; with an area of ~741 km<sup>2</sup>, it is the second largest district in the county, containing thirteen inhabited places (ten villages, one large village and two cities). The population of the county is around 204,000 people, as per most recent census data (population density: 276/km<sup>2</sup>).

The study population comprised of adult patients attending their general practitioner's (GP) offices in the District. Sample size for the adult population of the Szeged District was calculated by using the Raosoft sample size calculator [22], based on the formula below (1): population was N=169,300 (83% of the total population is aged 18 or older, as per most recent census data), x was confidence interval of 95%, E was the a margin of error set at 5% and the expected response rate set at 50%, based on the results of the Special Eurobarometer 407 [21]. The minimum sample size of n=103 (n=94 with an added contingency of 10% for non-responders and inappropriate responses) was set for the completion of this pilot survey.

$$n = N \frac{x}{(N-1)E^2 + x} \quad (1)$$

A total of 218 patients in five GPs' offices throughout the Szeged District were approached with our questionnaire, out of which 113 chose to participate in our survey (corresponding to a response rate of 51.9%, females were more inclined to participate). Four respondents (1.5%) were excluded due to incompletely filled out questionnaires; therefore n=109 were included in the final analysis.

### 2.2. Structure of the questionnaire

A literature review of similar surveys was conducted in the PubMed/MEDLINE database in order to identify potential questions for the development of the instrument in this study; in addition, some of the questions were based on the questions

of the Eurobarometer Survey 407 [21]. The questionnaire was adapted in accordance with local population characteristics and the questionnaires were developed in Hungarian language. The questionnaire was then reviewed and assessed by three faculty members (with extensive experience in survey research), a GP, a community pharmacist and a public health specialist for content and face validation and to ensure the clarity and ease of use during the survey. Minor modifications (rewording, reformatting or reordering of questions) were performed based on the comments of the evaluation panel.

The final structured questionnaire consisted of 33 questions covering three major areas: *Part I.* demographic characteristics and health status (nine items: age, sex, highest level of education, place of residence, employment status, subjective evaluation of health status, existence of chronic illnesses, reason for present GP-visit); *Part II.*: questions about the use and the procurement of ABs and the roles of HCPs in the eyes of the respondents (fourteen items); this section included single-choice, multiple-choice and open-ended questions, respectively. In addition, some of the questions had follow-up questions, therefore respondents were asked to fill out or skip specific questions depending on their answers; *Part III.*: questions on the knowledge and attitudes of the patients (five-five items each), adopted from the Eurobarometer survey: at the statements evaluating the respondents' knowledge on ABs, they had the option of choosing between 'True', 'False', and 'I don't know/Unsure about the answer', while during statements aiming to measure the attitude of respondents, a five-point Likert-scale ranging from "Strongly agree" to "Strongly disagree" was used to record the responses of the participants. Questions **QK1-QK4** (see [Table 3](#)) were used to create a composite knowledge-score (ranging between 0-4 for each correct statement) to allow for comparison with the results of the Eurobarometer surveys.

### 2.3. Data collection, statistical analysis

Data collection for the survey was running between January 2016 and January 2018. Prior to participating in the survey, the nature and purpose of the study was explained to the patients, including the data collection methods and that participation was voluntary. Participants were informed that the data collection, processing and analysis are anonymous. Data collectors also made sure that

the patients did not participate in the Eurobarometers regarding ABs in parallel (Special Eurobarometer 445: field work between April-May 2016; Flash Eurobarometer 444: field work between September-October 2016, respectively) [23]. No remuneration or gifts were given to participants to facilitate them to take part in the survey.

All questionnaires were checked manually and questionnaires with >90% completion were included in the analysis. All the completed questionnaires were entered into Epi-data version 3.1 and the data was exported to SPSS (Statistical Package for the Social Sciences) Statistics version 23.0 (IBM; Chicago, IL, USA) for data analysis. Descriptive statistics were used to analyze qualitative variables, while quantitative variables were summarized using mean  $\pm$  standard deviation ( $\pm$ SD). Univariate analysis was performed using Pearson's Chi-squared tests or Fisher's exact tests when comparing proportions, while Student's t-tests were utilized to assess the association between numerical values. All statistical tests were two-tailed, and results were considered to be statistically significant if  $p < 0.05$ .

### 2.4. Ethical approval

The survey was conducted in accordance with the Declaration of Helsinki and national and institutional ethical standards. Ethical approval for the study protocol was obtained from the Regional and Institutional Human Medical Biological Research Ethics Committee of the Szent-Györgyi Albert Clinical Centre, University of Szeged (registration number: 3688).

## 3. Results

### 3.1. Demographic characteristics, health status of respondents

The socio-demographic characteristics of the respondents are presented in [Table 1](#). The median age of the respondents was 51 years ( $50.8 \pm 17.8$  years, range: 19-93). The majority of respondents were from the seat of the district and the county (Szeged;  $n=62$ ; 56.9%), while other respondents were from villages (43.1%; Domaszék  $n=41$ , Szatymaz  $n=2$ , Deszk, Kistelek, Kiskundorozsma, Zákányszék  $n=1$ , respectively). Among the respondents, females (60.6%) and patients with the secondary-level education (61.5%) were represented in higher numbers.

**Table 1** Demographic characteristics of the participants

Characteristics	n (%)
<b>Gender</b>	
Female	66 (60.6%)
Male	43 (39.4%)
<b>Age</b>	
18-35 years	27 (24.4%)
36-64 years	50 (45.8%)
65 years or older	32 (29.8%)
<b>Place of residence</b>	
Urban	62 (56.9%)
Provincial	47 (43.1%)
<b>Level of education</b>	
Elementary school	12 (11.0%)
Trade school	28 (25.7%)
Secondary school	18 (16.5%)
Grammar school	21 (19.3%)
College/University	30 (27.5%)
<b>Employment status</b>	
Employed	50 (45.9%)
Unemployed/Looking for a job	6 (5.5%)
Pensioner	38 (34.9%)
Rehabilitation	2 (1.8%)
Disability pension	3 (2.7%)
Childcare benefit/allowance	3 (2.7%)
Student	7 (6.5%)

The respondents evaluated their current health status as bad in 9.3% of cases (2.8% and 6.5% for *very bad* and *bad*, respectively), while 41.7% responded with *moderate* and 51.9% with good (46.3% and 5.4% for *good* and *very good*, respectively) 53.7% (n=59) reported having a chronic illness which requires medical attention/pharmacotherapy (or has required therapy in the last 12 months): 51.7% of these patients reported one chronic disease, while 31.2%, 13.7% and 3.4% reported suffering from two, three and four chronic ailments respectively. The self-reported chronic illnesses were diseases of the cardiovascular system (30.4%), diabetes (type I and II; 21.8%), diseases of the locomotor system (16.3%), endocrine system (7.6%), pulmonary system (7.6%), kidney disease (5.4%), gastrointestinal system (5.4%), autoimmune disorders (2.2%), psychiatric disorders (2.2%) and malignant illness (1.1%). A significant association was found between the self-reported health status and the presence of chronic illnesses ( $p < 0.0001$ ), but not between age and chronic illnesses ( $p > 0.05$ ).

36.0% of respondents have visited the GPs' office to procure a prescription for themselves or

their family members, 31.3% due to an acute illness, 19.6% were on their follow-up visit, 5.5% came for the administration of a medicine or vaccine, 4.8% visited for a routine check-up (for employment purposes or for driving licenses), while 2.8% came for a referral letter to visit a specialist.

### 3.2. Antibiotic use, sources of antibiotics

80.7% (n=88) of respondents stated that they visit the GPs offices 0-2 times a year due to an infectious disease, while 14.7% (n=16) reported 3-4 and 4.6% (n=5) reported more, than 4 occasions, respectively. Patients were surveyed on the last time they took ABs (results are presented in [Table 2](#)): almost one-third (32.1%) has taken these drugs during the last 12 months. 90.5% (n=99) of respondents has obtained their last course of ABs through a medical prescription, 1.9% (n=2) had it administered by a medical practitioner, 4.8% (n=5) used leftover drugs from a previous course of therapy, while 2.8% (n=3) obtained it from a pharmacy, without a medical prescription.

By their own admission, 31.6% of respondents stated that the last time they took ABs was to treat sore throat, while 14.0% has taken them for a urinary tract infection, 13.2% to treat a cold, 7.4% for bronchitis, 6.6% to treat a flu or a persistent cough, 5.1% for pneumonia, 4.4% took it prophylactically after surgery, 2.9% took them after a dental procedure, 2.2% took them due to a skin and soft tissue infection or to treat diarrhoea and 1.5% took ABs to alleviate fever.

Patients were asked about their sources of information on ABs (multiple answers were allowed): medical doctors were perceived as the most trustworthy sources (70.6%), followed by community pharmacists (23.9%), the Internet (20.2%), previous secondary school/university education (19.3%), television and/or radio (18.3%), books, newspapers or information pamphlets (17.4%), family members (10.1%), friends or acquaintances (7.3%), other

**Table 2** Responses to the question 'When was the last time you took antibiotics?'

Last use of antibiotics	n (%)
<i>I have never taken antibiotics.</i>	4 (3.7)
<i>More than 5 years ago.</i>	20 (18.3)
<i>1-5 years ago.</i>	29 (26.6)
<i>In the last 12 months.</i>	35 (32.1)
<i>In the last month.</i>	10 (9.2)
<i>I am currently taking antibiotics.</i>	5 (4.6)
<i>I don't know/I don't remember.</i>	6 (5.5)



**Table 3** Statements measuring respondents' knowledge on ABs

	True n (%)	False n (%)	Unsure of the answer n (%)
<b>QK1</b> Antibiotics are effective against viruses. (Correct answer: False)	56 (51.4%)	35 (32.1%)	18 (16.5%)
<b>QK2</b> Antibiotics are effective therapy for the common cold and the flu. (Correct answer: False)	50 (46.3)	43 (39.8%)	15 (13.9%)
<b>QK3</b> Unnecessary and inappropriate (in dose or duration) use of antibiotics makes them become ineffective. (Correct answer: True)	86 (78.9%)	7 (6.4%)	16 (14.7%)
<b>QK4</b> Taking antibiotics often has side-effects such as diarrhea. (Correct answer: True)	74 (65.1%)	17 (15.6%)	21 (19.3%)
<b>QK5</b> When my symptoms are gone, I may stop taking the antibiotic safely. (Correct answer: False)	38 (34.8%)	65 (59.6%)	6 (5.6%)

healthcare-professionals, e.g., pharmacy assistants, nurses, health-promotion specialists (2.8%) and other sources (e.g. medicines information leaflet; 1.8%). There were no significant association between age or gender and the reported source of information ( $p>0.05$ ). One third of patients (34.9%;  $n=38$ ) have recalled receiving information about not taking antibiotics unnecessarily: most of these respondents got this information from their physicians (55.9%), in addition, community pharmacists, family members (11.8%, respectively), the Internet (8.8%), friends or acquaintances and the Internet (5.9%) were also identified. 88.2% ( $n=30$ ) of these patients chose to take this advice seriously. Older patients recalled receiving information on this topic much less frequently ( $p=0.021$ ).

In addition, patients were asked about their adherence to the medical advice from their respective HCPs: 65.1% stated that they always and completely follow the instructions of the physicians, while 33.9% stated that they generally take these instructions into account; complete adherence to the instructions of the community pharmacists was reported in 45.5%, while generally good adherence in 47.5% of respondents. Only a minority of respondents (0.9% regarding physicians' and 7.1% for pharmacists' instructions) stated that they generally do not follow the instructions of their respective healthcare-providers. 73.1% ( $n=79$ ) considered the purchase of additional medications or adjuvants (e.g., probiotics) with antibiotics if the pharmacist recommends it. 4.6% ( $n=5$ ) of patients reported trying to obtain antibiotics from a community pharmacist without a prescription, bypassing their physicians; 1.8% ( $n=2$ ) of respondents successfully obtained these drugs from a pharmacy. Additionally, 17.8% agreed (5.9% , 7.9% ), that they would be able to source antibiot-

ics without a medical prescription, if there were a need for it (53.5% and 22.8% with this statement, while 9.9% was of the answer). This was more prevalent in respondents from Szeged ( $p=0.023$ ), than from respondents from surrounding villages.

### 3.3. Knowledge and attitude about antibiotics, socio-demographic and key variable analysis

The responses for the knowledge-based questions, adapted from the Eurobarometer survey are presented in [Table 3](#). 18.3% ( $n=20$ ) of respondents gave correct answers to all relevant questions (**QK1-QK4**), while 7.3% ( $n=8$ ) had zero correct answers; the highest number of respondents could answer two questions (43.1%;  $n=47$ ) correctly. The average number of correct answers overall were  $2.11\pm1.16$ ; there were no statistically significant differences among the results of respondents from Szeged ( $2.27\pm1.10$ ) and respondents from the surrounding villages ( $1.89\pm1.19$ ;  $p>0.05$ ). Similarly, no correlation was found between the number of correct answers and age, current health status, presence/absence of chronic illness, employment status or number of GP visits per year ( $p>0.05$ ). There was, however, association found with the highest level of education ( $p<0.001$ ); the same association was also found when considering the number of correct answers to **QK5** ( $p=0.029$ ). In addition, respondents who reported to use antibiotics for inappropriate indications (e.g., sore throat, cold, flu, fever) had worse results in the knowledge-based questions (**QK1-4**  $p=0.03$ ; **QK5**  $p=0.047$ ).

The respondents' beliefs regarding ABs and prevention (questions **QA1-5**) are summarized in [Table 4](#). Of note, 75% of respondents believe that ABs are medicines of special importance (**QA1**); there was no correlation between this positive

**Table 4** Patients' attitudes towards antibiotics and preventative measures to avoid contracting infectious diseases

Statements	SD	D	U/DK n (%)	A	SA
	Disagree n (%)			Agree n (%)	
<b>QA1</b> Antibiotics are medicines of special importance.	5 (4.6%)	11 (10.2%)	11 (10.2%)	37 (34.3%)	44 (40.7%)
<b>QA2</b> My knowledge regarding infectious diseases is appropriate.	3 (2.8%)	20 (18.5%)	15 (13.9%)	48 (44.4%)	22 (20.4%)
<b>QA3</b> Personal hygiene and taking care of ourselves have important roles in the prevention of infectious diseases.	1 (0.9%)	0 (0%)	0 (0%)	26 (23.9%)	82 (75.2%)
<b>QA4</b> Vaccines are an important means of preventing infectious diseases.	8 (7.4%)	6 (5.6%)	10 (9.3%)	31 (28.7%)	53 (49.1%)
<b>QA5</b> The media devotes enough energy to disseminate information on infectious diseases.	16 (15.0%)	26 (24.3%)	17 (15.9%)	29 (27.1%)	19 (17.8%)

SD: strongly disagree, D: disagree, U/DK: I don't know/Unsure, A: agree, SA: strongly agree

statement and the participant's age, gender or the number of correct answers (see previous section), however, participants with higher levels of education ( $p=0.048$ ) and those, who reportedly visit the GP's office more frequently due to infections ailments ( $p=0.021$ ) were more likely to have such beliefs. Only 64.8% of the respondents regarded their knowledge about infectious diseases as appropriate (**QA2**). Interestingly, women were more satisfied with their knowledge-level ( $p<0.001$ ), while satisfaction-level and the number of correct answers showed no association ( $p>0.05$ ). In a similar fashion, women were more likely to be dissatisfied with the involvement of the media in disseminating relevant information on infectious diseases to the public (**QA5**;  $p=0.024$ ); although 44.9% agreed and 39.3% of the patients disagreed with the statement. All respondents agreed on the role of personal hygiene and personal care (100%) in infectious disease-prevention, however, the role of vaccines in this regard was clear to only 77.8% of participants (**QA3** and **QA4**, respectively).

4. Discussion

In the present study, the knowledge level and attitudes of patients towards ABs and antibiotic resistance, in addition to their drug utilization practices were assessed in the Szeged District of Hungary. We have found that around 32% of respondents have taken ABs in the last 12 months, mainly for a sore throat. They identified healthcare professionals as the most trustworthy sources of information, moreover they generally follow their advices; while the Internet also emerged as an important information source, verifying the results of previous reports [24]. Just minority (4.8%) used leftover

ABs for their last course, and 2.8% accessed to non-prescribed ABs from a pharmacy. This latter is in line with the result of a European study, where 1-9% of the population was identified generally to obtain ABs without a prescription from a pharmacy [25]. Regarding the knowledge level of the respondents, we have found that most patients were aware of the emergence of bacterial resistance and the potential adverse events that may occur during AB use, however, many respondents identified colds, the flu and viral infections in general as indications for AB therapy. Based on our results, correlation was found between the highest level of education, AB-related knowledge and the appreciation of the role of ABs in healthcare, which is line with other reports available in the literature [26,27].

The methodology and instrument used for this survey was based and adapted from the Eurobarometer survey on AMR by the European Commission, one of the two most important international studies, the Special Eurobarometer reports (Flash EBM 444 [28] in 2016, EBM 445 [23] in 2016 and EBM 478 in 2018 [39], respectively) commissioned by the European Union, and the 'Antibiotic Resistance: Multi-country awareness survey' for non-EU countries, performed by the WHO [30]. The highlights of the abovementioned reports are summarized in Table 5, serving as a contrast to the results of the present study. The average number of correct answers in the study region (2.1) was in line with previous reports of the Hungarian national average (in the EBMs 338, 407 and 445), however, in the last EBM, both the European overall average and the national average of Hungary has increased (2.6 and 2.3, respectively) [21,23,28-30].

**Table 5** Summary of the findings of the Special Eurobarometer reports (EU) and the 'Antibiotic Resistance: Multi-country awareness survey' (WHO) on AB-related knowledge and AB utilization [21,23,28-30].

Survey (Year)	Antibiotics in the last 12 months (EU)	Source of antibiotics (EU)	Anti-biotics taken for the flu	Anti-biotics taken to treat a cold	Average number of correct answers (EU)	Anti-biotics are effective against the cold and flu	Anti-biotics are effective against viruses	All answers (n=4) are correct
<b>EBM 407 (2013) [21]</b>	35%; highest in Malta (48%), lowest in Sweden (24%)	From a medical prescription/ pharmacy: 95%; 3% from a pharmacy, without a prescription; 2% leftover from home	18%	13%	2.4 (Hungary: 2.1); highest in Sweden (3.1), lowest in Romania (1.5)	41%	49%	22%
<b>EBM 445 (2016) [23]</b>	34%; highest in Malta (48%), lowest in Sweden (18%)	From a medical prescription/ pharmacy: 93%; 4% from a pharmacy, without a prescription; 3% leftover from home	16%	11%	2.5 (Hungary: 2.2); highest in Finland (3.1), lowest in Italy (1.9)	44%	43%	24%
<b>EBM 478 (2018) [29]</b>	32%; highest in Italy (47%), lowest in Sweden (20%)	From a medical prescription/ pharmacy: 93%; 3% from a pharmacy, without a prescription; 4% leftover from home	12%	8%	2.6 (Hungary: 2.3); highest in Finland and Sweden (3.1), lowest in Romania and Latvia (2.1)	48%	28%	25%
<b>WHO Multi-country survey (2015) [30]</b>	35%; higher in lower income countries (42%), lower in higher income countries (29%)	From a medical prescription/ pharmacy: 93%; 2% from a pharmacy, without a prescription; 2% leftover from home; 3% from a friend or family member, 1% from the Internet	-	-	-	64%	-	-

By the recommendations of the European Surveillance of Antimicrobial Consumption Network (ESAC-Net), AB use in adults is only indicated in around 0-30% of cases in upper respiratory tract infections, acute tonsillitis, acute or chronic sinusitis, acute otitis media, acute bronchitis or bronchi-

olitis, while for acute cystitis and pneumonia, this ratio is 80-100% [10,11]. Several national and international studies have described gaps in public knowledge and issues regarding inappropriate AB use [11,18,31-34], characterized by their procurement through non-prescription (predominantly

from pharmacies) and non-medical (leftover drugs, drugs from family members or friends) sources. These studies have all highlighted the role of self-medication of antibiotics as a minor (0.5-8%), but still significant portion of AB consumption. In addition, the ignorance (risk-taking behaviour) or lack of understanding towards ineffectiveness of ABs against viral infections (and the common cold) was also identified in a plethora of publications: many people identify all disease-causing pathogens as “germs”, not distinguishing their biological characteristics and the subsequent therapeutic approach needed to treat them [11,18,31-34].

Educational campaigns and behavioural AMR strategies are essential to address both the knowledge-based and social aspects of inappropriate AB use in the public, including the lowering of expectations for AB prescriptions, and the highlighting of the dangers associated with AMR [35]. On the other hand, healthcare professionals’ responsibility on the matter also has to be highlighted: as the doctor-patient and pharmacist-patient relationship is unbalanced (from the standpoint of medical information), patients will adhere to the advice received (also highlighted by the results of this study) and feed off of the inappropriate behaviors and attitudes of the respective healthcare professionals [17,36,37]. Thus, it may be concluded that without structural changes in the healthcare infrastructure of a relevant country, true change cannot be attained [38].

Some limitations of this study must be acknowledged (which were also present in the standardized Eurobarometer instrument): i) some of the questions rely on the respondents’ memory, which may lead to discrepancies or bias; ii) the principal assumption of the study is that the knowledge level and attitude of patients will indefinitely determine their practices towards ABs and the practices of the respondents were not measured directly; iii) the presence of social desirability bias in some of the questions; iv) geographical limitations (the study may only represent the patients of the Szeged District).

## 5. Conclusions

As the number of available antibiotics is dwindling, one of the most important steps to preserve the efficacy of existing drugs is the use of educational campaigns in an attempt to augment the health behaviour of patients. Our paper aimed at

the assessing and understanding of AMR-related general population behaviour in the Szeged District of Hungary, in a descriptive antibiotic-related questionnaire, based on the methodology of the Special Eurobarometer reports of the European Commission. As a highlight to our study, higher education levels were associated with better knowledge and attitudes, in addition, the majority of respondents were not aware of the differences between bacterial and viral infections and their treatment. This study has built on existing research and generated data which may be used for the designing and implementation of awareness campaigns, based on the needs of the local community.

## Author Contributions

M.G. and A.S. conceived and designed the study, performed data collection and analysis, wrote and revised the full paper. E.P. supervised the completion of the study wrote and revised the full paper.

## Funding

This research received no external funding.

## Acknowledgments

The authors would like to express their gratitude to the patients who participated in this study. The authors would like to acknowledge the help of Gábor Oszlanczi MD PhD, Emese Petra Balogh MD PhD, Judit Baranyai MD, Nándor Pördi MD and Gábor Kőrösi MD in reaching the participants of this study. Part of this study was presented at the 28th European Congress of Clinical Microbiology and Infectious Diseases (ECCMID).

## Conflicts of Interest

The author declares no conflicts of interest, monetary or otherwise.

## References

1. Cassini A, Högberg DL, Plachouras D, Qattrocchi A, Hoxha A, Simonsen G, Colomb-Cotinat M, Kretzschmar ME, Devleeschauwer B, Cecchini M, Ouakrim DA, Oliviera CT, Struelens MJ, Suetens C, Monnet DL, Burden of AMR Collaborative Group. Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis. *Lancet Infect Dis* 2019; 19: 56-66. [https://doi.org/10.1016/S1473-3099\(18\)30605-4](https://doi.org/10.1016/S1473-3099(18)30605-4)



2. Gajdács M, Zupkó I. Az antibiotikum rezisztencia krízis: lépést tudnak-e tartani a gyógyszerfejlesztő cégek? [The antibiotic resistance crisis: can pharmaceutical companies keep up with the pace?] (article in Hungarian). *Gyógyszerészet* 2019; 63: 736-742.
3. Spellberg B. The future of antibiotics. *Crit. Care.* 2014; 18: 228. <https://doi.org/10.1186/cc13948>
4. Gajdács M. The Concept of an Ideal Antibiotic: Implications for Drug Design. *Molecules* 2019; 24: e892. <https://doi.org/10.3390/molecules24050892>
5. WHO Global Strategy for Health for All by the Year 2000. [Internet] [cited 7 January 2020]. Available from: [https://iris.wpro.who.int/bitstream/handle/10665.1/6967/WPR\\_RC032\\_GlobalStrategy\\_1981\\_en.pdf](https://iris.wpro.who.int/bitstream/handle/10665.1/6967/WPR_RC032_GlobalStrategy_1981_en.pdf)
6. WHO Global action plan on antimicrobial resistance. [Internet] [cited 7 January 2020]. Available from: [https://apps.who.int/iris/bitstream/handle/10665/193736/9789241509763\\_eng.pdf?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/193736/9789241509763_eng.pdf?sequence=1)
7. Adeel Aslam, Márió Gajdács, Che Suraya Zin, Norny Syafinaz Binti Abd Rahman, Syed Imran Ahmed, Shazia Jamshed: Public Awareness and Practices towards Self-Medication with Antibiotics among the Malaysian Population. A Development of Questionnaire and Pilot-Testing. *Antibiotics* 2020; 9: e97. <https://doi.org/10.3390/antibiotics9020097>
8. Founou RC, Founou LL, Essack SY. Clinical and economic impact of antibiotic resistance in developing countries: A systematic review and meta-analysis. *PLoS One* 2017; 12: e0189621. <https://doi.org/10.1371/journal.pone.0189621>
9. ESAC-Net. Antimicrobial consumption in the EU/EEA Annual epidemiological report for 2018. [Internet] [cited 7 January 2020]. <https://www.ecdc.europa.eu/sites/default/files/documents/Antimicrobial-consumption-EU-EEA.pdf>
10. Matuz M, Benkő R, Dóró P, Hajdú E, Nagy E, Monnet DL, Soós G. Regional variations in community consumption of antibiotics in Hungary, 1996-2003. *Br J Clin Pharmacol* 2006; 61: 96-100. <https://doi.org/10.1111/j.1365-2125.2005.02525.x>
11. Abduelkarem AR, Othman AM, Abuelkhair ZM, Ghazal MM, Alzouobi SB, Zowalaty MEE. Prevalence Of Self-Medication With Antibiotics Among Residents In United Arab Emirates. *Infect Drug Res* 2019; 12: 3445-3453. <https://doi.org/10.2147/IDR.S224720>
12. Barbosa TM, Levy SB. The impact of antibiotic use on resistance development and persistence. *Drug Res Updat* 2000; 3: 303-311. <https://doi.org/10.1054/drup.2000.0167>
13. Gajdács M, Szabó A. Orvosok antibiotikum felhasználással és rezisztenciával kapcsolatos véleményének vizsgálata Magyarország délkeleti részén. [Physicians' opinions towards antibiotic use and resistance in the southeastern region of Hungary] (article in Hungarian). *Orv Hetil*, accepted.
14. Gajdács M, Paulik E, Szabó A. Közforgalomban dolgozó gyógyszerészek antibiotikum felhasználással és rezisztenciával kapcsolatos véleménye [The opinions of community pharmacists related to antibiotic use and resistance] (article in Hungarian). *Acta Pharm Hung* 2018; 88: 249-252.
15. Jamshed S, Padzil F, Shamsudin SH, Bux SH, Jamaluddin AA, Bhagavathula AS, Azhar S, Hassali MA. Antibiotic Stewardship in Community Pharmacies: A Scoping Review. *Pharmacy* 2018; 6: e92. <https://doi.org/10.3390/pharmacy6030092>
16. WHO Competency Framework for health workers' education and training on antimicrobial resistance. [Internet] [cited 7 January 2020]. Available from: <http://apps.who.int/medicinedocs/documents/s23443en/s23443en.pdf>
17. ECDC. Survey of healthcare workers' knowledge, attitudes and behaviours on antibiotics, antibiotic use and antibiotic resistance in the EU/EEA. [Internet] [cited 7 January 2020]. Available from: <https://www.ecdc.europa.eu/sites/default/files/documents/survey-of-healthcare-workers-knowledge-attitudes-behaviours-on-antibiotics.pdf>
18. Zajmi D, Berisha M, Begolli I, Hoxha R, Mehmeti R, Mulliqi-Osmeni G, Kurti A, Loku A, Raka L. Public knowledge, attitudes and practices regarding antibiotic use in Kosovo. *Pharmacy Practice* 2017; 15: 827. <https://doi.org/10.18549/PharmPract.2017.01.827>
19. Macfarlane J, Holmes W, Macfarlane R, Britten N. Influence of patients' expectations on antibiotic BMJ 1997; 315: 1211-14. <https://doi.org/10.1136/bmj.315.7117.1211>
20. Mangione-Smith R, McGlynn EA, Elliott MN, Krogsstad P, Brook RH. The relationship between perceived parental expectations and pediatrician antimicrobial prescribing behavior. *Pediatrics* 1999; 103: 711-18. <https://doi.org/10.1542/peds.103.4.711>
21. European Commission. Special Eurobarometer 407: Antimicrobial Resistance. [Internet] [cited 7 January 2020]. Available from: [https://ec.europa.eu/comfrontoffice/publicopinion/archives/ebs/ebs\\_407\\_en.pdf](https://ec.europa.eu/comfrontoffice/publicopinion/archives/ebs/ebs_407_en.pdf)
22. Raosoft Sample Size Calculator. [Internet] [cited 7 January 2020]. Available from: <http://www.raosoft.com/samplesize.html>
23. European Commission. Special Eurobarometer 445: Antimicrobial Resistance. [Internet] [cited 7 January 2020]. Available from: [https://ec.europa.eu/health/amr/sites/amr/files/eb445\\_amr\\_generalreport\\_en.pdf](https://ec.europa.eu/health/amr/sites/amr/files/eb445_amr_generalreport_en.pdf)
24. Mandle G, Kostkova P, Weinberg J. Bugs and drugs on the Web: changes in knowledge of users of a web-based education resource on antibiotic prescribing. *J Antimicrob Chemother* 2009; 63: 221-223. <https://doi.org/10.1093/jac/dkn438>
25. Safrany N, Monnet DL. Antibiotics obtained without a prescription in Europe. *Lancet Infect Dis.* 2012; 12: P182-P183. [https://doi.org/10.1016/S1473-3099\(12\)70017-8](https://doi.org/10.1016/S1473-3099(12)70017-8)
26. de Bont EGPM, Alink M, Falkenberg FCJ, Dinant GJ, Cals JWL. Patient information leaflets to reduce antibiotic use and reconsultation rates in general practice: a systematic review. *BMJ Open* 2015; 5: e007612. <https://doi.org/10.1136/bmjopen-2015-007612>
27. Burstein VR, Trajano RP, Kravitz RL, Bell RA, Vora D, May LS. Communication interventions to promote the public's awareness of antibiotics: a systematic review. *BMC Public Health* 2019; 19: e899. <https://doi.org/10.1186/s12889-019-7258-3>
28. European Commission. Flash Eurobarometer 444: Antimicrobial Resistance. [Internet] [cited 7 January 2020]. Available from: <https://ec.europa.eu/comfrontoffice/publicopinion/index.cfm/ResultDoc/download/DocumentKy/75687>
29. European Commission. Special Eurobarometer 478: Antimicrobial Resistance. [Internet] [cited 7 January 2020]. Available from: [https://ec.europa.eu/comfrontoffice/publicopinion/archives/ebs/ebs\\_478\\_en.pdf](https://ec.europa.eu/comfrontoffice/publicopinion/archives/ebs/ebs_478_en.pdf)

- ary 2020]. Available from: <http://ec.europa.eu/com-mfrontoffice/publicopinion/index.cfm/ResultDoc/download/DocumentKy/84386>
30. WHO. Antibiotic Resistance: multi-country public awareness survey <https://apps.who.int/medicinedocs/documents/s22245en/s22245en.pdf>
31. Vallin M, Polyzoi M, Marrone G, Rosales-Klintz S, Tegmark WK, Stalsby LC. Knowledge and Attitudes towards Antibiotic Use and Resistance - A Latent Class Analysis of a Swedish Population-Based Sample. *PLoS One* 2016; 11: e0152160. <https://doi.org/10.1371/journal.pone.0152160>
32. Mazinska B, Struzycka I, Hryniewicz W. Surveys of public knowledge and attitudes with regard to antibiotics in Poland: Did the European Antibiotic Awareness Day campaigns change attitudes? *PLoS One* 2017; 12: e0172146. <https://doi.org/10.1371/journal.pone.0172146>
33. Ramchurren K, Balakrishna Y, Mahomed S Patients' knowledge, attitudes and practices regarding antibiotic use at a regional hospital in KwaZulu-Natal, South Africa 2017. *S Afric J Infect Dis* 2018; 33: a146. <https://doi.org/10.4102/sajid.v33i5.146>
34. Kong LS, Islahudin F, Muthupalaniappen L, Chong WW. Knowledge and Expectations on Antibiotic Use among Older Adults in Malaysia: A Cross-Sectional Survey. *Geriatrics* 2019; 4: e61. <https://doi.org/10.3390/geriatrics4040061>
35. Matthew P, Sivaraman S, Chandy S. Communication strategies for improving public awareness on appropriate antibiotic use: Bridging a vital gap for action on antibiotic resistance. *J Family Med Prim Care* 2019; 8: 1867-1871. [https://doi.org/10.4103/jfmpe.jfmpe\\_263\\_19](https://doi.org/10.4103/jfmpe.jfmpe_263_19)
36. Gajdács M, Paulik E, Szabó A Közforgalomban dolgozó gyógyszerészek attitűdvizsgálata a fertőző betegségekkel kapcsolatos szerepkörük kiszélesítésére vonatkozóan Magyarország délkeleti részén [The attitude of community pharmacists towards their widening roles in the prevention and treatment of infectious diseases in the southeast region of Hungary] (article in Hungarian). *Gyógyszerészet* 2019; 63: 26-30.
37. Rábano-Blanco A, Domínguez-Martins EM, Mosteiro-Miguéns DG, Freire-Garabal M, Novio S. Nursing Students' Knowledge and Awareness of Antibiotic Use, Resistance and Stewardship: A Descriptive Cross-Sectional Study. *Antibiotics* 2019; 8: e203. <https://doi.org/10.3390/antibiotics8040203>
38. Malik B, Bhattacharyya S. Antibiotic drug-resistance as a complex system driven by socio-economic growth and antibiotic misuse. *Sci Rep* 2019; 9: e9788. <https://doi.org/10.1038/s41598-019-50846-1>